
Date : Aug 23, 2012

TECHNICAL DATA	
Product Name	TX54D72VC0BAA

(NOTES)

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RECORD OF REVISIONS

Date	Sheet No.	Summary

DESCRIPTION

Note : The LED driver for the backlight unit is integrated within this module.

Product Name : TX54D72VC0BAA

GENERAL SPECIFICATIONS

Effective Display Area	: (H)431.616 × (V)323.712 (mm)
Number of Pixels	: (H)2,048 × (V)1,536 (pixels)
Aspect ratio	: 4 : 3
Pixel Pitch	: (H)0.21075 × (V)0.21075 (mm)
Color Pixel Arrangement	: R+G+B Vertical Stripe
Display Mode	: Transmissive Mode Normally Black Mode
Frame frequency	: 60 Hz
Top Polarizer Type	: Anti-glare (Surface hardness: 2H)
Number of Colors	: 1,073,741,824 colors (10bit)
LCM Mode	: IPS-Pro
Input Signal	: 4-channel LVDS (LVDS = Low Voltage Differential Signaling)
Back Light	: Edge Light Type with White LED
External Dimensions	: (H)460.6 × (V)359.0 × (t)29.0 typ. (mm)
Weight	: 3,200g typ.(3,400g max.)

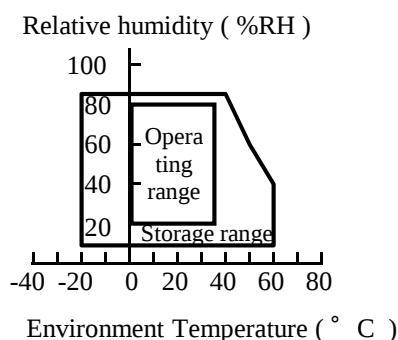
1. ABSOLUTE MAXIMUM RATINGS

1.1 ENVIRONMENT ABSOLUTE MAXIMUM RATINGS

Item	Operating		Storage		Unit	Note
	Min.	Max.	Min.	Max.		
Panel surface Temperature	0	60	-20	60	°C	1)
Humidity	2)		2)		%RH	1)
Vibration	-	2.45 (0.25G)	-	14.7 (1.5G)	m/s ²	3),5)
Shock	-	14.7 (1.5G)	-	294 (30G)	m/s ²	4),5)
	-	14.7 (1.5G)	-	490 (50G)	m/s ²	4),6)
Corrosive Gas	Not Acceptable		Not Acceptable		-	
Illumination at LCD Surface	-	50,000	-	50,000	lx	
TCON Surface Temperature	-	85	-	85	°C	7)

Notes

- 1) Temperature and Humidity should be applied to the panel surface of the TFT module and not to the system installed with the module.
- 2) $T_a \leq 40^{\circ}\text{C}$: Relative humidity should be less than 85%RH max. Dew is prohibited.
 $T_a > 40^{\circ}\text{C}$: Relative humidity should be lower than the moisture of the 85%RH at 40°C .



- 3) Frequency of vibration is between 15Hz and 100Hz, except resonance point and z-direction (panel face top and bottom).
- 4) Pulse width of the shock wave pattern is 10ms approximately.
- 5) LCD module mounted with chassis by screwed all 4 positions, which 4 positions are right and left side. (chassis thickness should be 1.5mm max.)
- 6) LCD module must be mounted with chassis by screwed all 8 positions, which 4 positions are top and bottom side, other 4positions are on right and left side.
- 7) FPGA-IC

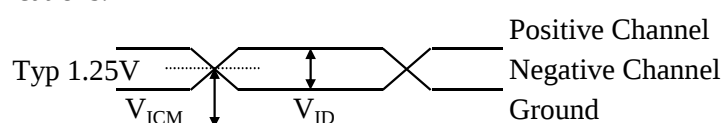
1.2 ELECTRICAL ABSOLUTE MAXIMUM RATINGS

(1) TFT-LCD Module

$V_{SS} = 0 \text{ V}$

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V_{DD}	0	13.2	V	
Input Differential voltage swing	V_{ID}	100	900	mV	1)
Input common mode voltage	V_{ICM}	500	1800	mV	1)
Electrostatic Durability	V_{ESD0}	± 100		V	2),3)
	V_{ESD1}	± 8		kV	2),4)

Notes 1) It is applied to LVDS specifications.



2) Discharge Coefficient: 200pF-250Ω, Environmental: 25°C-70%RH

3) It is applied to I/F connector pins.

4) It is applied to the surface of a metallic bezel and a LCD panel.

(2) LED driver

$V_{SS} = 0 \text{ V}$

Item	Symbol	Min.	Max.	Unit	Note
Input Voltage	V_{IN}	0	28.0	V	
ON/OFF Control Input Voltage	ON/OFF	0	5.5	V	
Analog dimming signal Voltage	VBR	0	3.6	V	1)
PWM dimming signal Voltage	PWM	0	5.5	V	1)

Notes 1) These signals can't input at the same time.

2. INITIAL OPTICAL CHARACTERISTICS

The following optical characteristics are measured under stable conditions. It takes about 30 minutes to reach stable conditions. The measuring point is the center of display area unless otherwise noted. The optical characteristics should be measured in a dark room or equivalent environment.

Measuring equipment : CS-1000A or CA-210, EZ-contrast

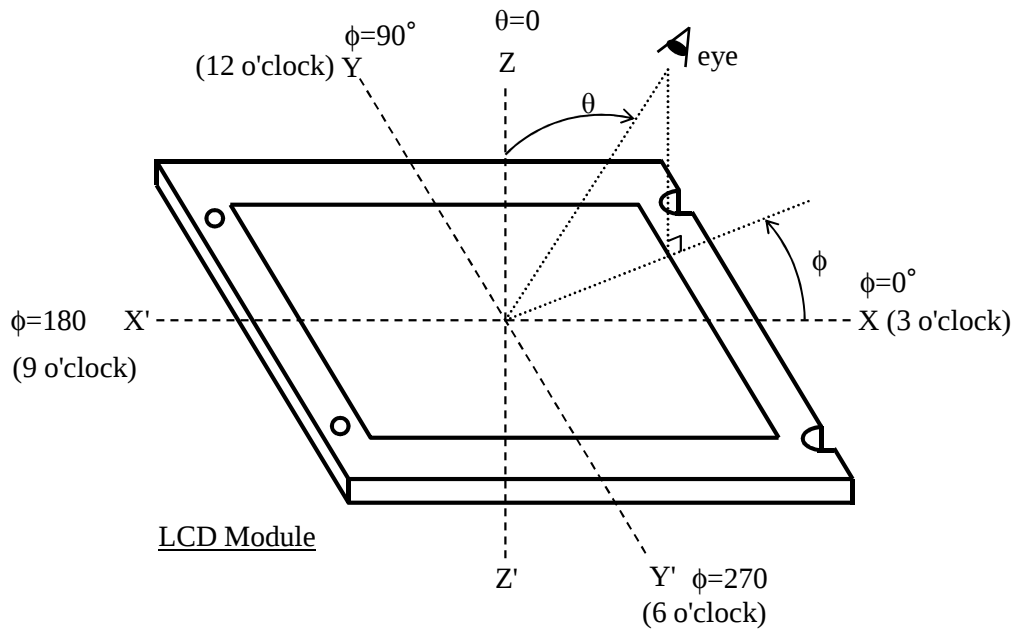
Ambient Temperature =25±3°C, VDD=12.0V, fV=60Hz, Vin=24V

2.1 SPECIFICATION

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	$\theta = 0^\circ$ 1)	800	1400	—	—	2)
Response Time	Rise	ton		—	12	22	ms	3)
	Fall	toff		—	10	20		
Brightness of white		Bwh		800	1000	—	cd/m ²	6)
Brightness uniformity		Buni		70	—	—	%	4)
Color Chromaticity (CIE)	Red	x		0.626	0.656	0.686	—	Gray scale = 1023
		y		0.296	0.326	0.356		
	Green	x		0.274	0.304	0.334		
		y		0.592	0.622	0.652		
	Blue	x		0.120	0.150	0.180		
		y		0.023	0.053	0.083		
	White	x		0.269	0.299	0.329		
		y		0.285	0.315	0.345		
Variation of Color Position (CIE)	Red	Δx	$\theta = +60^\circ$ $\phi = 0^\circ, 90^\circ$ $180^\circ, 270^\circ$ 1)	—	—	0.040	—	5) Gray scale = 1023
		Δy		—	—	0.040		
	Green	Δx		—	—	0.040		
		Δy		—	—	0.040		
	Blue	Δx		—	—	0.040		
		Δy		—	—	0.040		
	White	Δx		—	—	0.040		
		Δy		—	—	0.040		
Contrast Ratio at 85°		CR85°	$\theta = +85^\circ$ $\phi = 0^\circ, 90^\circ$ $180^\circ, 270^\circ$ 1)	50	—	—	—	—

Notes

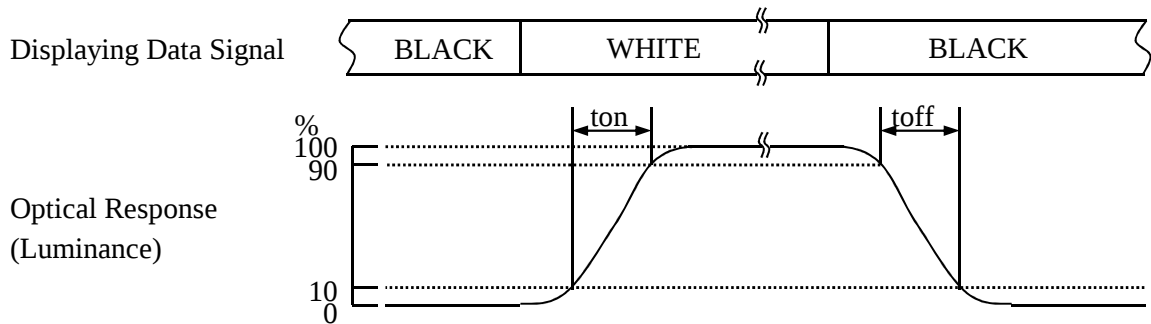
1) Definition of Viewing Angle (gray scale = 1023)



2) Definition of Contrast Ratio (CR)

$$CR = \frac{\text{(Luminance at displaying WHITE)}}{\text{(Luminance at displaying BLACK)}}$$

3) Definition of Response Time



Panel surface temperature = 40°C

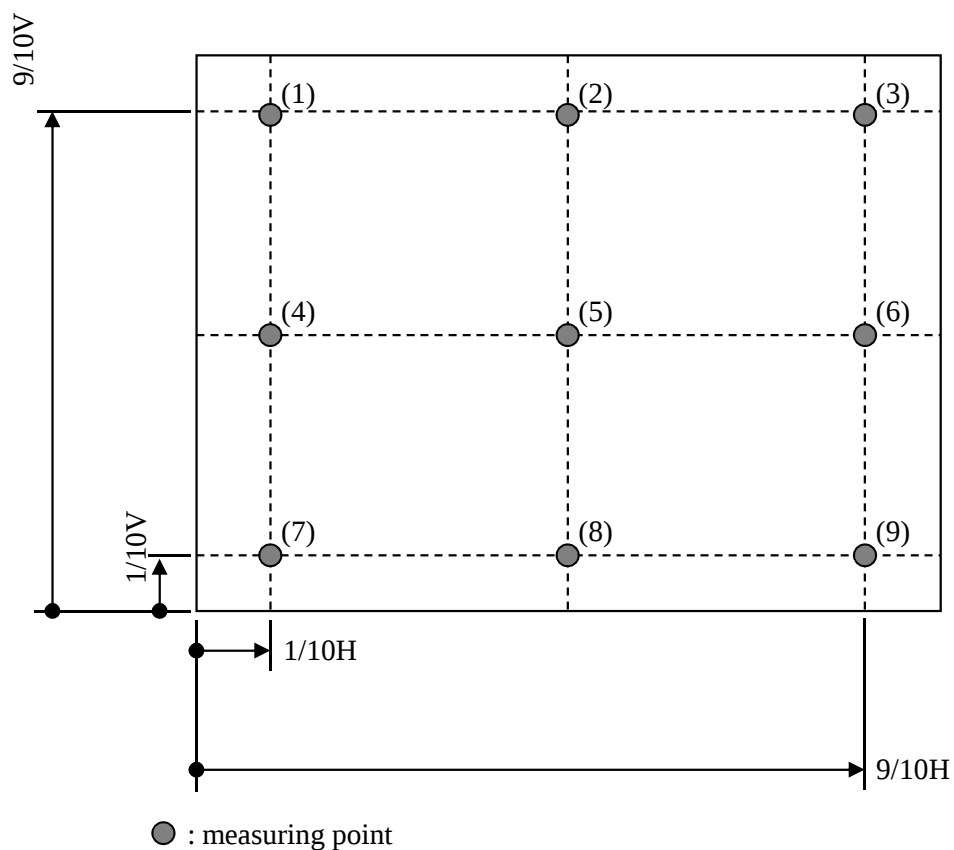
4) Definition of Brightness Uniformity

Display pattern is white (1023 level). The brightness uniformity is defined by the following equation. Brightness at each point is measured and then Buni can be calculated using the maximum and minimum brightness values.

$$Buni = \left(\frac{Bmin}{Bmax} \right) \times 100$$

where, Bmax = Maximum brightness.

Bmin = Minimum brightness.



5) Variation of color position on CIE is defined as difference between colors for TFT-LCD module.

$$u' = \frac{4x}{-2x + 12y + 3} \quad v' = \frac{9y}{-2x + 12y + 3}$$

6) PWM voltage should be 3.0V through 3.3V (Duty : 100%).

7) These specifications should be applied with initial performances when it will be shipped.

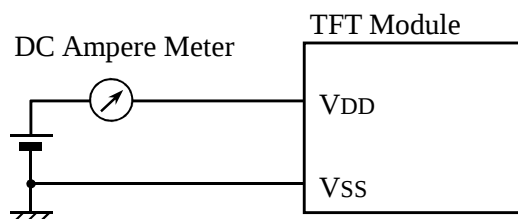
3. ELECTRICAL CHARACTERISTICS

3.1 TFT-LCD MODULE

Ta=25°C, Vss=0V

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage	VDD	11.4	12.0	12.6	V	
Power Supply Current	IDD	-	1.0	1.1	A	1),2)
Ripple Voltage of Power Supply	VDDR	-	-	0.15	V	

Notes 1) DC current at fv=60.0Hz, fCLK=65MHz, VDD=12.0V and display pattern is a full White (1023).



- 2) A protection fuse is built into this module. Current capacity of the power supply for VDD should be greater than 5A, so that the fuse can 'blow' if there is a problem with the power supply.

3.2 BACK LIGHT

Item	Symbol	Value			Unit	Note
		Min	Typ	Max		
Input Voltage	Vin	21.6	24.0	26.4	V	
Input Current	Iin	-	2.48	2.74	A	
Input Power	Pin	-	-	59.1	W	
ON/OFF Control	ON/OFF	2.5	-	5.0	V	
Input Voltage		0.0	-	0.8	V	
PWM dimming signal	PWM	High	3.0	-	5.0	Vdc
Input Voltage		Low	0.0	-	0.9	Vdc
PWM Duty	-	5	-	100	%	
PWM Frequency	PWMf	140	150	160	Hz	1)

Notes 1) PWM Frequency

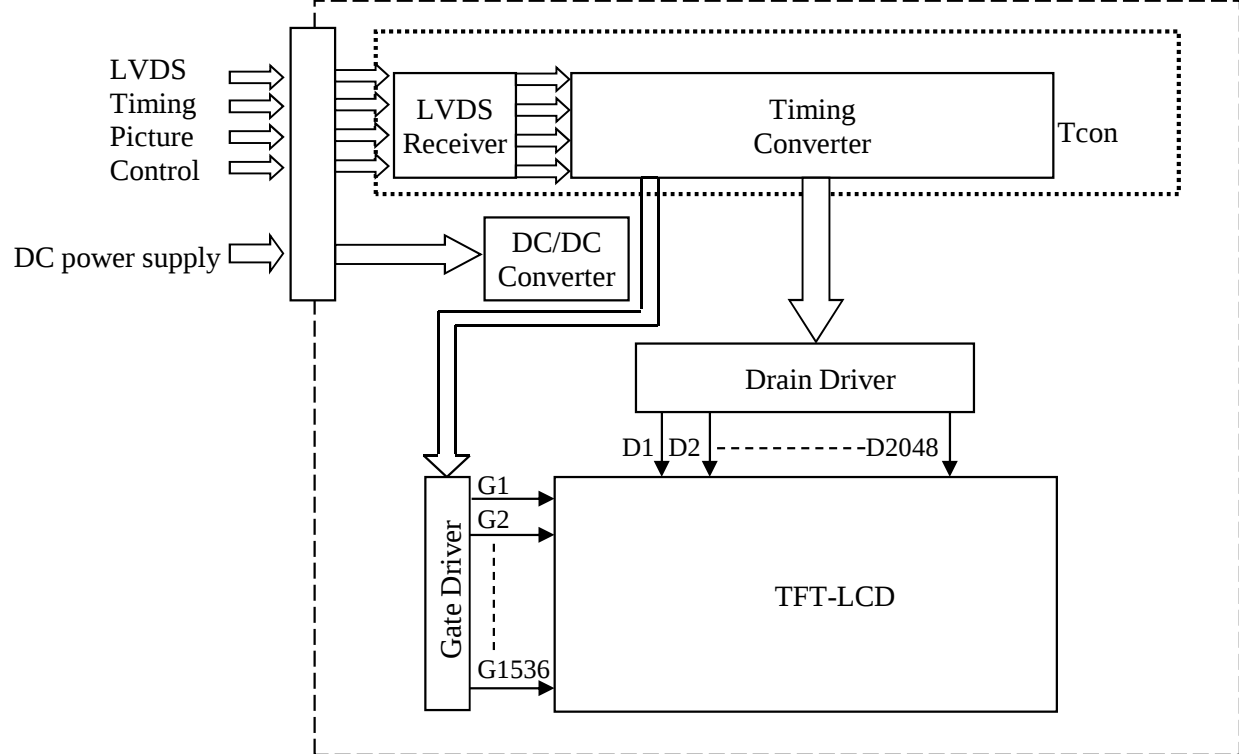
It could be operate at 100~1000Hz.

However,display specifications
should be applied at 140~160Hz.

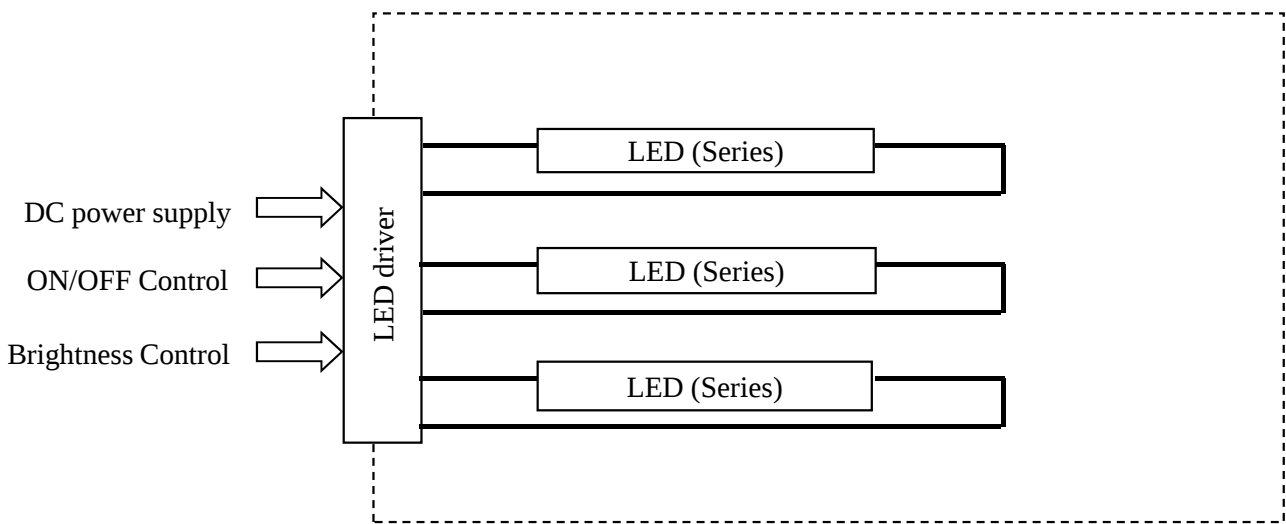
- 2) A protection fuse is built into this module. Current capacity of the power supply for Vin should be greater than 8A, so that the fuse can 'blow' if there is a problem with the power supply.

4. BLOCK DIAGRAM

(1) TFT Module



(2) Back light unit



5. INTERFACE PIN ASSIGNMENT

5.1 TFT-LCD MODULE

INPUT CONNECTOR : HIROSE

Plug FX15S-41S-0.5SH (PCB connector side)

FX15S-41P-C (cable side)

LEFT I/F connector (CN1)
(CH1, 2)

Power Supply	1	V _{DD}
	2	V _{DD}
	3	V _{DD}
	4	V _{DD}
	5	V _{DD}
	6	V _{SS}
	7	V _{SS}
	8	V _{SS}
	9	V _{SS}
CH1	10	ARX0n
	11	ARX0p
	12	ARX1n
	13	ARX1p
	14	V _{SS}
	15	ARX2n
	16	ARX2p
	17	ACLKn
	18	ACLKp
	19	V _{SS}
	20	ARX3n
	21	ARX3p
	22	ARX4n
	23	ARX4p
	24	V _{SS}
CH2	25	BRX0n
	26	BRX0p
	27	BRX1n
	28	BRX1p
	29	V _{SS}
	30	BRX2n
	31	BRX2p
	32	BCLKn
	33	BCLKp
	34	V _{SS}
	35	BRX3n
	36	BRX3p
	37	BRX4n
	38	BRX4p
	39	V _{SS}
	40	NC
	41	NC

CH1: ARXn/p

CH2: BRXn/p

RIGHT I/F connector (CN2)
(CH3, 4)

Power Supply	1	V _{DD}
	2	V _{DD}
	3	V _{DD}
	4	V _{DD}
	5	V _{DD}
	6	V _{SS}
	7	V _{SS}
	8	V _{SS}
	9	V _{SS}
CH3	10	CRX0n
	11	CRX0p
	12	CRX1n
	13	CRX1p
	14	V _{SS}
	15	CRX2n
	16	CRX2p
	17	CCLKn
	18	CCLKp
	19	V _{SS}
	20	CRX3n
	21	CRX3p
	22	CRX4n
	23	CRX4p
	24	V _{SS}
CH4	25	DRX0n
	26	DRX0p
	27	DRX1n
	28	DRX1p
	29	V _{SS}
	30	DRX2n
	31	DRX2p
	32	DCLKn
	33	DCLKp
	34	V _{SS}
	35	DRX3n
	36	DRX3p
	37	DRX4n
	38	DRX4p
	39	V _{SS}
	40	NC
	41	NC

CH3: CRXn/p

CH4: DRXn/p

5.2 BACK-LIGHT UNIT

CN3 : JST S14B-PH-SM4-TB (Inverter PCB Connector side)

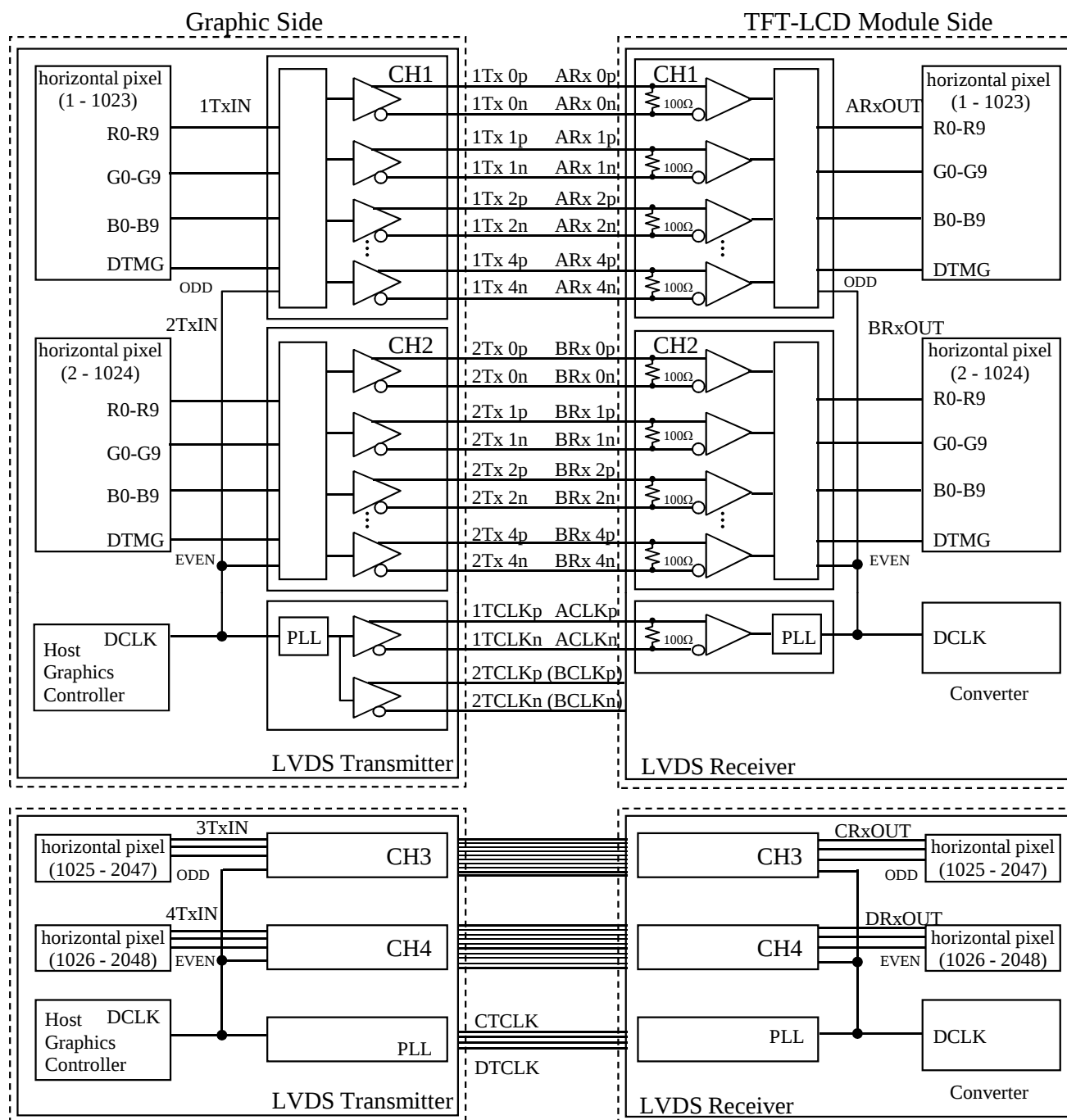
(Matching connector : JST PHR-14 (Cable side))

Pin No.	Symbol	Description	Note
1	V _{IN}	Power Supply (typ. 24.0V)	1)
2	V _{IN}		
3	V _{IN}		
4	V _{IN}		
5	V _{IN}		
6	V _{SS}	GND (0V)	2)
7	V _{SS}		
8	V _{SS}		
9	V _{SS}		
10	V _{SS}		
11	NC	NC	
12	ON/OFF	High : LED ON, Low : LED OFF	
13	NC	NC (Open)	3)
14	PWM	PWM dimming signal	

Notes

- 1) All VIN pins should be connected to +24.0V (Typ.).
- 2) All VSS pins should be grounded. The metal bezel is internally connected to GND.
- 3) This pin is connected to internal circuit. It should be open.

5.3 BLOCK DIAGRAM OF INTERFACE



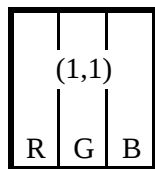
R0 ~ R9 : Pixel R Data
 G0 ~ G9 : Pixel G Data
 B0 ~ B9 : Pixel B Data
 DTMG : Display timing signal
 DCLK : Dot Clock

Notes 1) The host system must have the transmitter in-situ to drive the module.

2) LVDS cable impedance should be 100 ohms per twisted-pair line when used differentially.

5.4 CORRESPONDENCE BETWEEN INPUT DATA AND DISPLAY IMAGE

Display data of adjacent pixel is latched during one cycle of DCLK.



pixel : R0 ~ R9 : R data
G0 ~ G9 : G data
B0 ~ B9 : B data

1,1	3,1	5,1	...	1023,1	2,1	4,1	6,1	...	1024,1	1025,1	1027,1	1029,1	...	2047,1	1026,1	1028,1	1030,1	...	2048,1
1,2	3,2	5,2	...	1023,2	2,2	4,2	6,2	...	1024,2	1025,2	1027,2	1029,2	...	2047,2	1026,2	1028,2	1030,2	...	2048,2
1,3	3,3	5,3	...	1023,3	2,2	4,3	6,3	...	1024,3	1025,3	1027,3	1029,3	...	2047,3	1026,3	1028,3	1030,3	...	2048,3
1,4	3,4	5,4	...	1023,4	2,4	4,4	6,4	...	1024,4	1025,4	1027,4	1029,4	...	2047,4	1026,4	1028,4	1030,4	...	2048,4
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1,1536	3,1536	5,1536	...	1023,1536	2,1536	4,1536	6,1536	...	1024,1536	1025,1536	1027,1536	1029,1536	...	2047,1536	1026,1536	1028,1536	1030,1536	...	2048,1536

CH1 (LEFT_ODD)

CH2 (LEFT_EVEN)

CH3 (RIGHT_ODD)

CH4 (RIGHT_EVEN)

5.5 RELATIONSHIP BETWEEN DISPLAY COLORS AND INPUT SIGNALS

Input Color		Red Data								Green Data								Blue Data							
		R9	R8	R7	...	R3	R2	R1	R0	G9	G8	G7	...	G3	G2	G1	G0	B9	B8	B7	...	B3	B2	B1	B0
		MSB								LSB								MSB							
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1023)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (1023)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue (1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	Red (1022)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1023)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
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	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green (1022)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green (1023)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
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	Blue (1022)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue (1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Notes 1) Definition of gray scale :

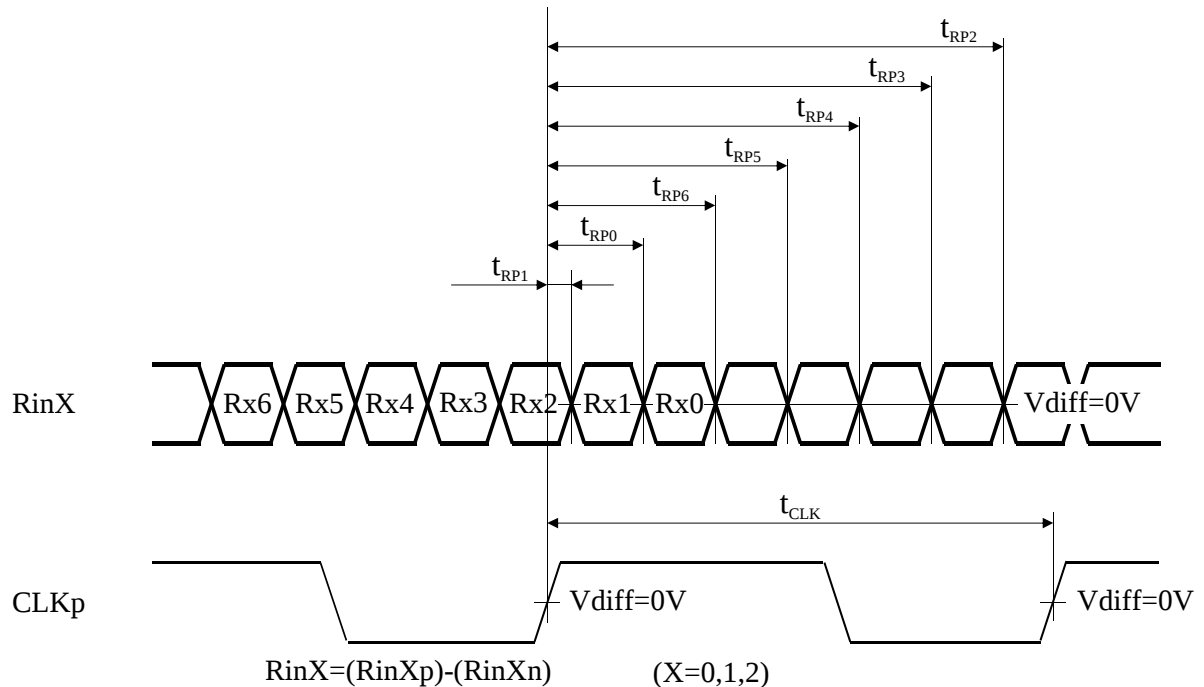
Color (n) : Number in parenthesis indicates gray scale level. Larger n corresponds to a brighter level.

2) Data : 1 : High, 0 : Low

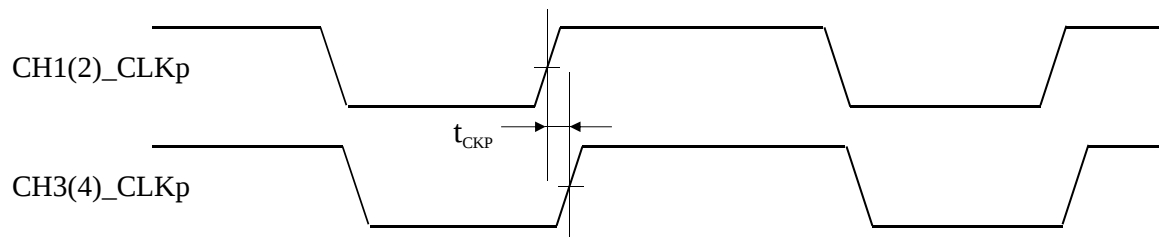
6. INTERFACE TIMING

6.1 LVDS RECEIVER TIMING CHARACTERISTICS

(Regulation with the Input Terminal of the Module)

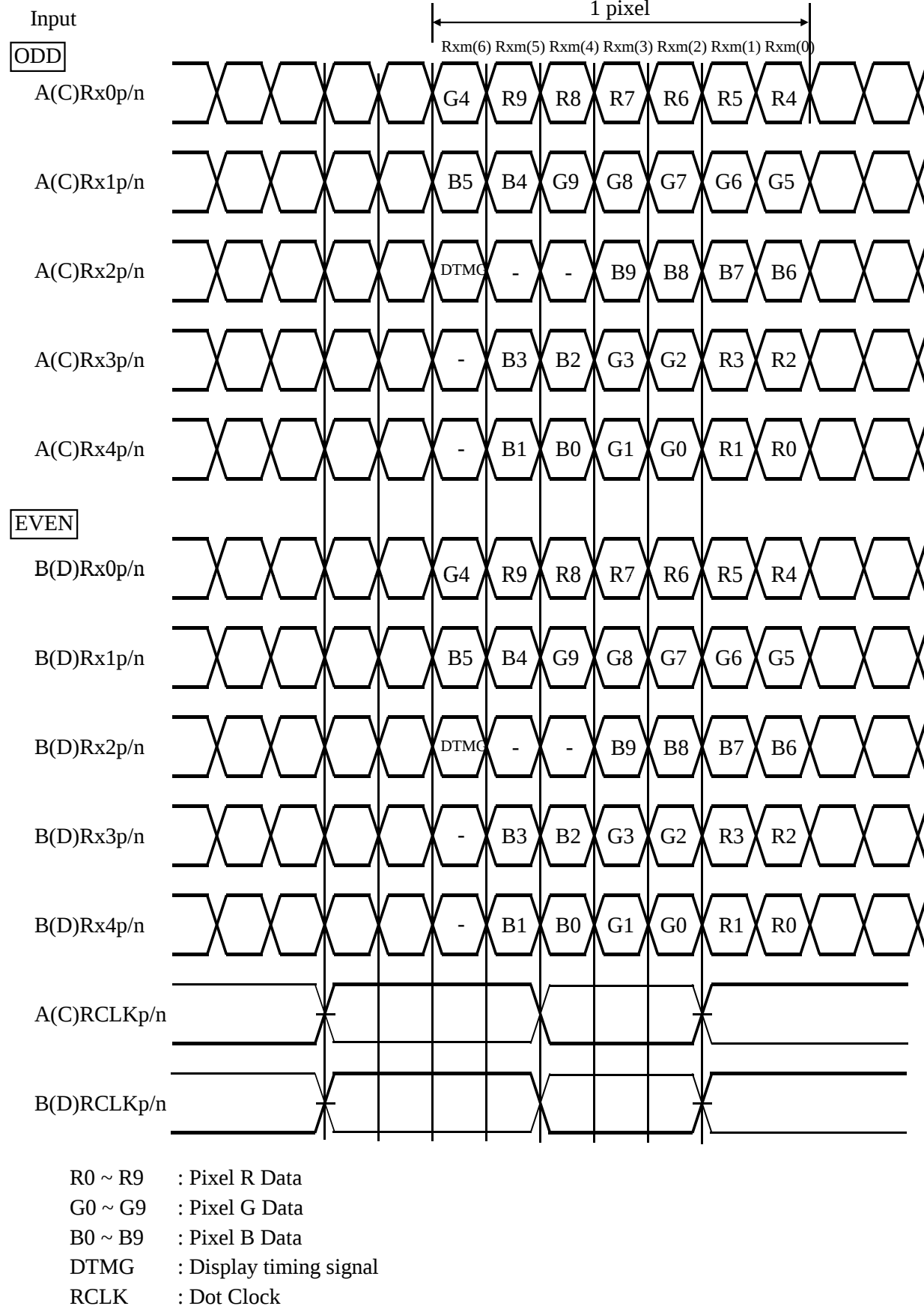


Item		Symbol	Min.	Typ.	Max.	Unit	Remarks
DCLK	Parameter	$1/t_{CLK}$	60	65	66	MHz	
t_{sk}	Skew Margin	$1/t_{CLK}=60\text{MHz}$	-650	0	+650	ps	
		$1/t_{CLK}=65\text{MHz}$	-570	0	+570		
		$1/t_{CLK}=66\text{MHz}$	-550	0	+550		
RinX (X=0,1,2)	Input Data Position0	t_{RP0}	$\frac{1}{7} t_{CLK}^{-tsk}$	$\frac{1}{7} t_{CLK}$	$\frac{1}{7} t_{CLK}^{+tsk}$	ns	
	Input Data Position1	t_{RP1}	0	0	0		
	Input Data Position2	t_{RP2}	$\frac{6}{7} t_{CLK}^{-tsk}$	$\frac{6}{7} t_{CLK}$	$\frac{6}{7} t_{CLK}^{+tsk}$		
	Input Data Position3	t_{RP3}	$\frac{5}{7} t_{CLK}^{-tsk}$	$\frac{5}{7} t_{CLK}$	$\frac{5}{7} t_{CLK}^{+tsk}$		
	Input Data Position4	t_{RP4}	$\frac{4}{7} t_{CLK}^{-tsk}$	$\frac{4}{7} t_{CLK}$	$\frac{4}{7} t_{CLK}^{+tsk}$		
	Input Data Position5	t_{RP5}	$\frac{3}{7} t_{CLK}^{-tsk}$	$\frac{3}{7} t_{CLK}$	$\frac{3}{7} t_{CLK}^{+tsk}$		
	Input Data Position6	t_{RP6}	$\frac{2}{7} t_{CLK}^{-tsk}$	$\frac{2}{7} t_{CLK}$	$\frac{2}{7} t_{CLK}^{+tsk}$		

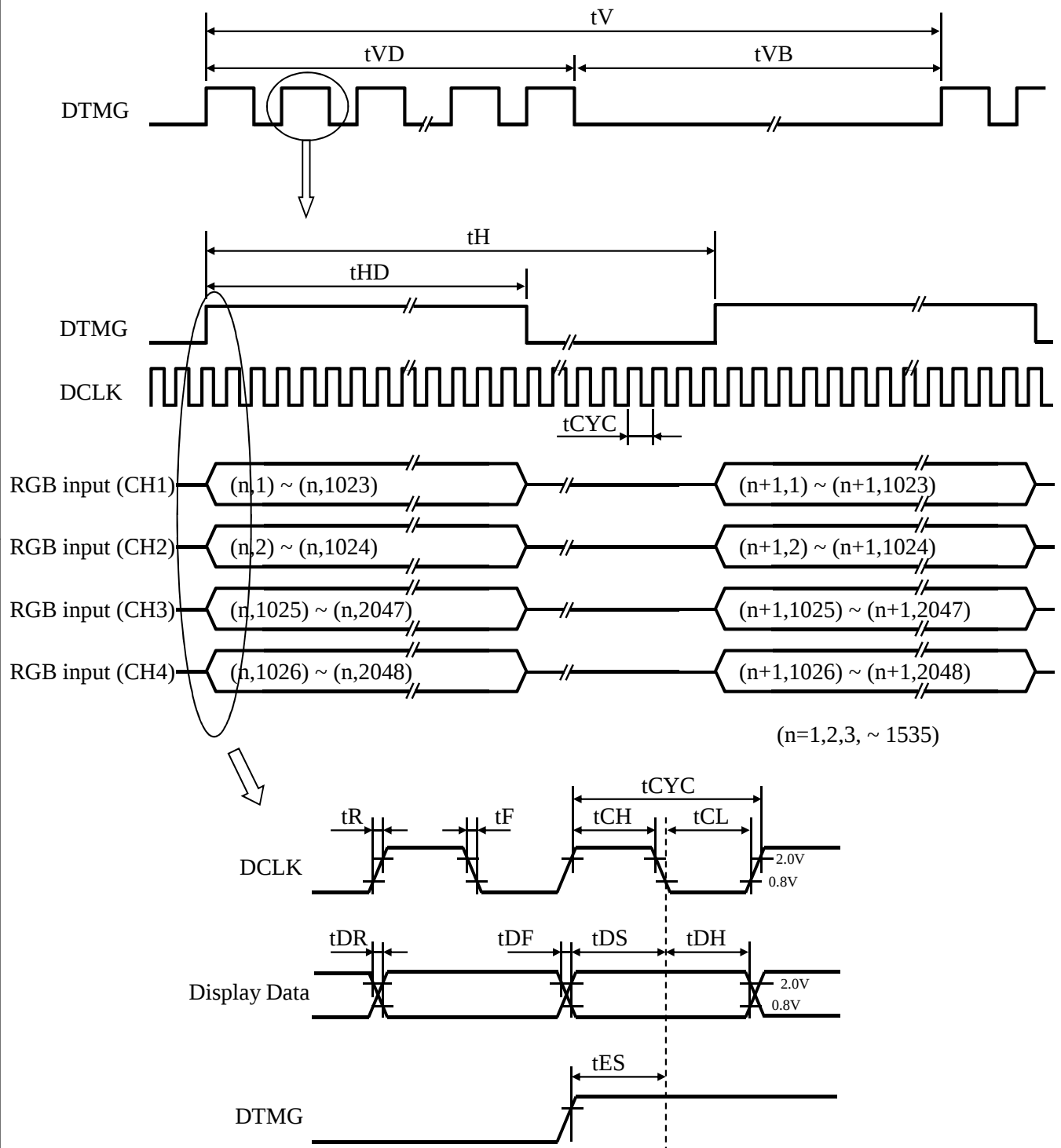


Item		Symbol	Min.	Typ.	Max.	Unit	Remarks
CLKp	Input CLK Position	t_{CKP}	-1	0	+1	DCLK	

6.2 LVDS MAPPING



6.3 TIMING CHART



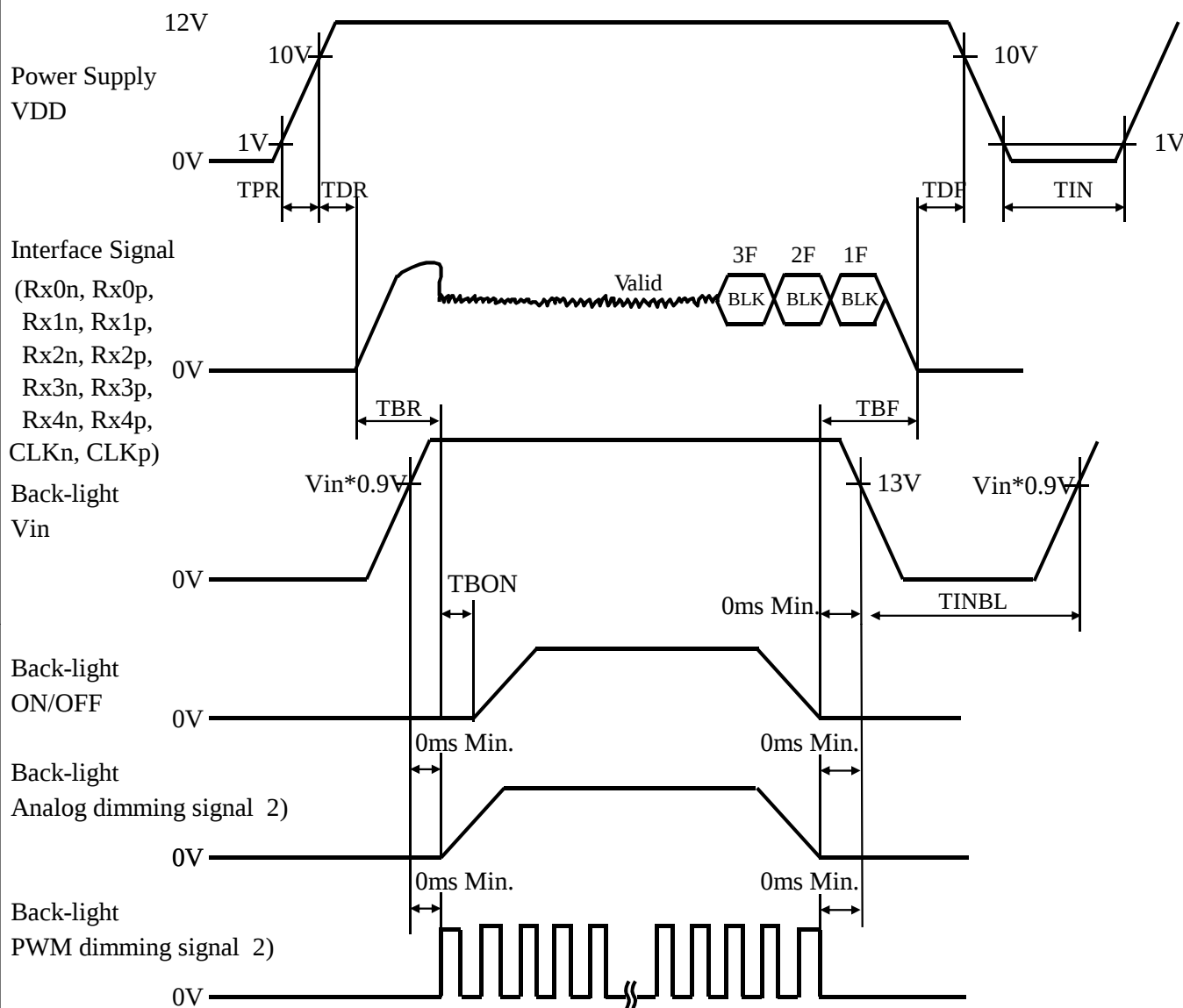
6.4 INTERFACE TIMING SPECIFICATIONS

	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	1/tCYC	60	65	66	MHz	1)
	Width High	tCH	3	-	-	ns	
	Width Low	tCL	3	-	-	ns	
	Rise Time	tR	-	-	3	ns	
	Fall Time	tF	-	-	3	ns	
	Duty	tCH/tCL	45	50	55	%	
DTMG	Period (Hor)	tH	640	672	700	tCK	
	Width Active (Hor)	tHD	512	512	512	tCK	
	Period (Ver)	tV	1547	1612	1628	tH	
	Width Active (Ver)	tVD	1536	1536	1536	tH	
	Setup Time	tES	4	-	-	ns	
Display Data	Rise Time	tDR	-	-	3	ns	
	Fall Time	tDF	-	-	3	ns	
	Set up Time	tDS	3	-	-	ns	
	Hold Time	tDH	3	-	-	ns	

Note

- 1) Since DCLK and inverter driving frequency are optimized, please be noted that DCLK should be set within this spec. Otherwise, optical side effect may happen.

6.5 TIMING BETWEEN INTERFACE SIGNALS AND POWER SUPPLY



Note

1) Timing of the power supply voltage and input signals should be set using the following specifications.

$0\text{ms} \leq \text{TPR} \leq 10\text{ms}$

$10\text{ms} \leq \text{TDR} \leq 50\text{ms}$

$-10\text{ms} \leq \text{TDF} \leq 50\text{ms}$

*Before the end of the Interface Signal, black image is shown for the last 3 frames. Refer to above Interface Signal Timing.

$\text{TIN} \geq 1000\text{ms}$

$\text{TBR} \geq 500\text{ms}$

$\text{TBF} \geq 100\text{ms}$

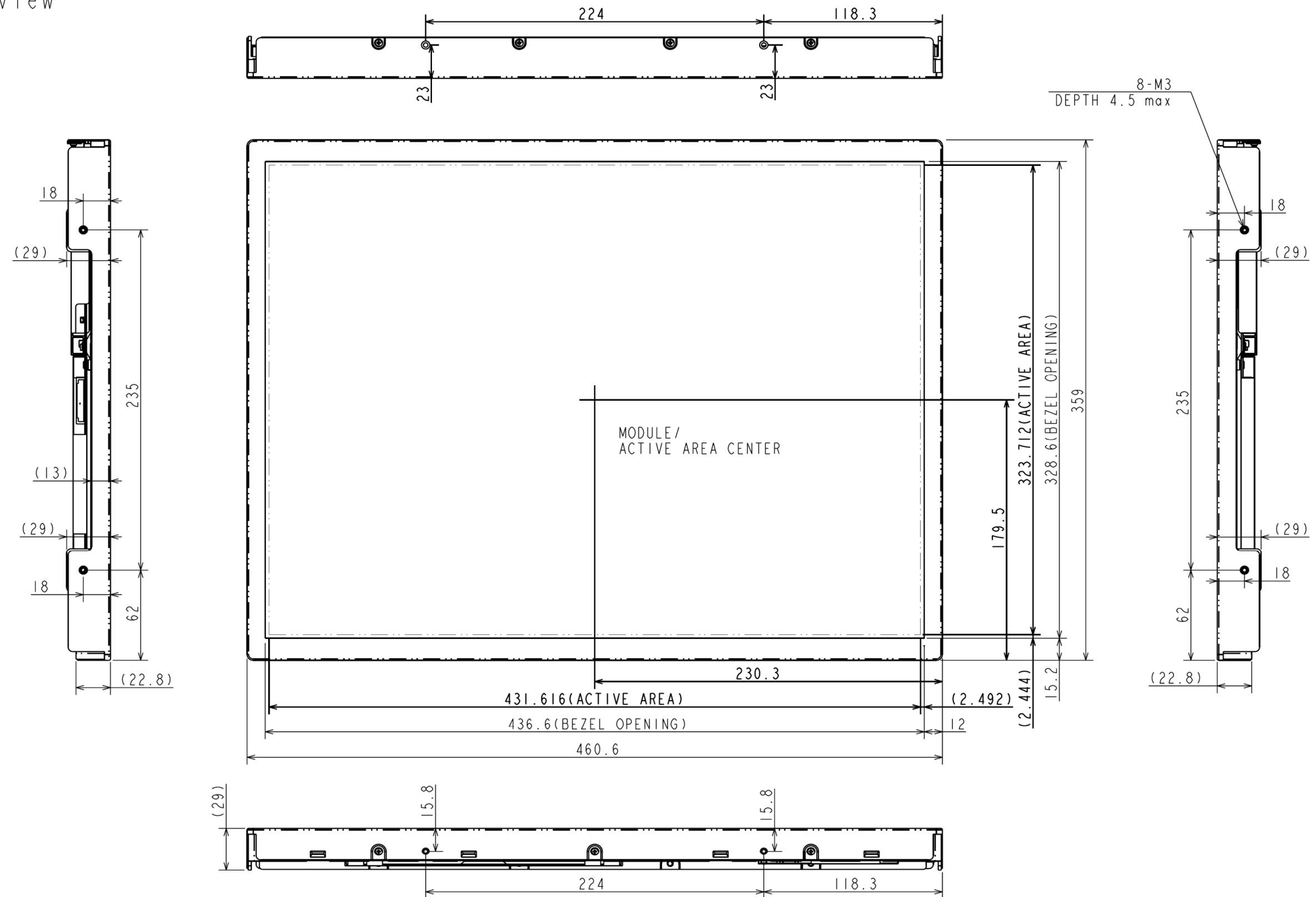
$\text{TBON} > 0\text{ms}$

$\text{TINBL} \geq 1000\text{ms}$

2) These signals can't input at the same time.

7. DIMENSIONAL OUTLINE

(1) Front View



Note 1) Dimension in parentheses are reference value.

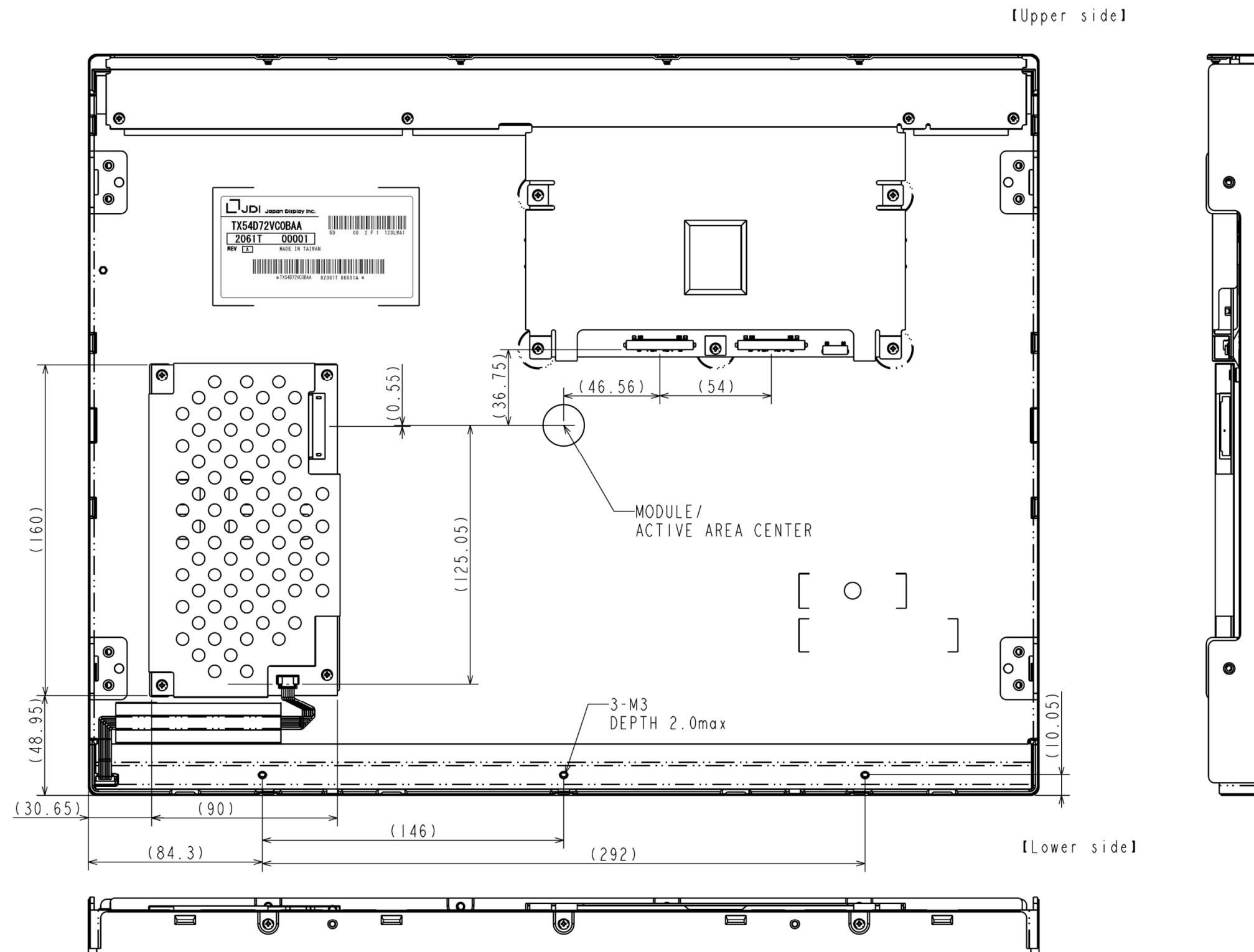
2) Tolerance not specified is ± 1.0 mm.

3) Maximum torque for M3 screw: 0.44N·m.

Mounting chassis thickness : 1.5mm max.

Unit:mm
Scale:NTS

(2)Rear View



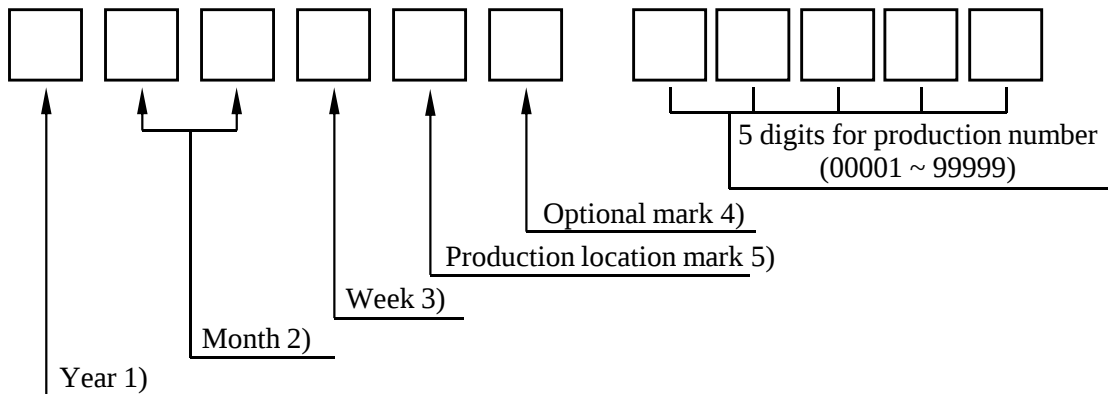
Note 1) dimension in parentheses are reference value.

2) LED driver is protected by the plastic cover. For this cover, please take the clearance at least 10mm from conductive materials such as back chassis in order to suppress the electromagnetic coupling.

Unit:mm
Scale:NTS

8. DESIGNATION OF LOT MARK

8.1 LOT MARK



Notes 1)

Year	Mark
2011	1
2012	2
2013	3
2014	4
2015	5

2)

Month	Mark	Month	Mark
1	01	7	07
2	02	8	08
3	03	9	09
4	04	10	10
5	05	11	11
6	06	12	12

3)

Week (Day)	Mark
1 ~ 7	1
8 ~ 14	2
15 ~ 21	3
22 ~ 28	4
29 ~ 31	5

4) for Japan Display internal use only.

5)

Production management sign	
H	Made in Japan
T	Made in Taiwan

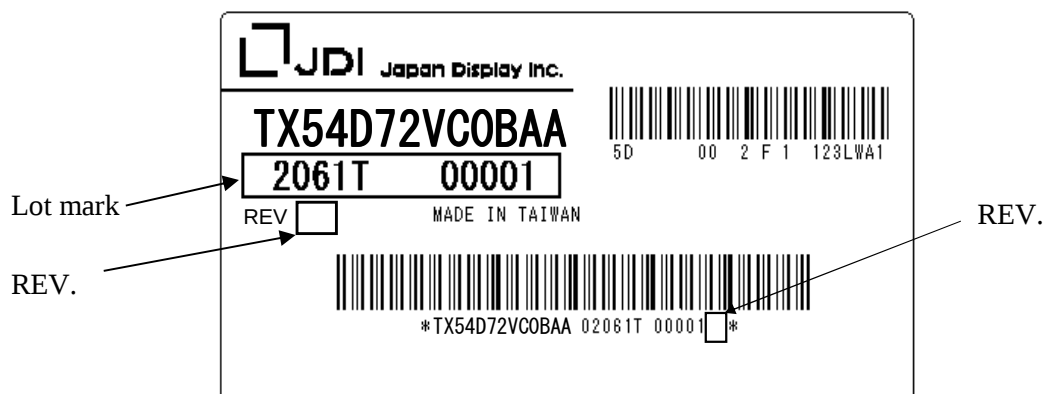
8.2 REVISION (REV.) CONTROL

Revision version is denoted by letter A through Z, except I and O, for Japan Display manufacturing convenience.

Rev.	Note

8.3 LOCATION OF LOT MARK

The Lot mark is printed on a label which is attached to the rear bezel, as shown in 7. External Dimensional. The style of character can be changed without prior notice.



9. COSMETIC SPECIFICATIONS

9.1 CONDITIONS FOR COSMETIC INSPECTION

(1) Viewing zone

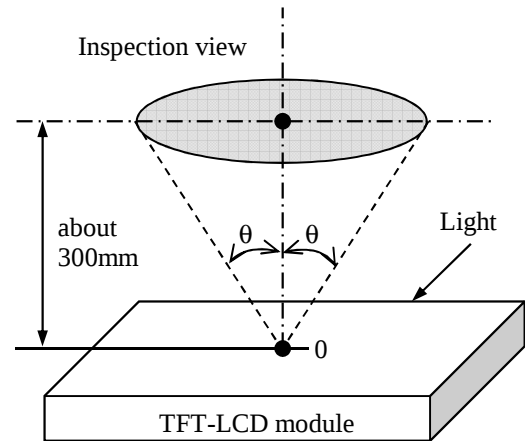
- a) The figure shows the correspondence between eyes (of inspector) and TFT-LCD module.

$\theta < 45^\circ$: when non-operating inspection

$\theta < 5^\circ$: when operating inspection

- b) Inspection should be executed only from front side and only A-zone.

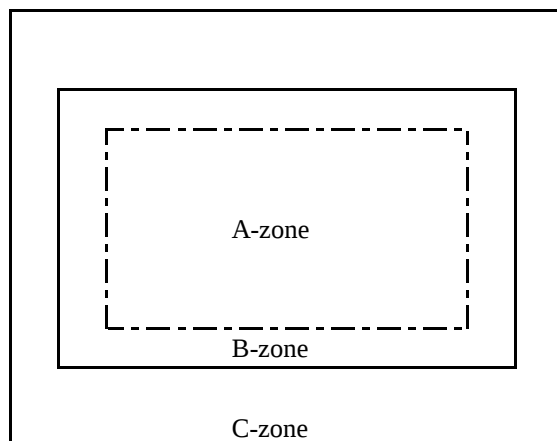
Cosmetic of B-zone and C-zone are ignore.
(refer to 9.2 DEFINITION OF ZONE)



(2) Environmental

- a) Temperature : 25°C
- b) Ambient light : sufficient darker condition when operating inspection.
: about 1000 lx and non-directive when non-operating inspection.
- c) Back-light : when non-operating inspection, back-light should be off.

9.2 DEFINITION OF ZONE



- A-zone : Display area (pixel area).
- B-zone : Area between A-zone and C-zone.
- C-zone : Metal bezel area.
(Include I/F connector)

9.3 COSMETIC SPECIFICATIONS

When displaying condition is not stable (ex. at turn on or off),
the following specifications are not applied.

	No.	Item			Max. acceptable number A-zone	Unit	Note
Operating inspection	1	Dot Defect	Sparkle mode	1-dot	3	pcs	1), 3)
				2-dots	2	Units	1), 4)
				3-dots	0		
				4-dots	0		
				Density	2	pcs/φ20mm	1), 5)
				Total	5	pcs	1)
			Black mode	1-dot	7	pcs	2), 3)
				2-dots	3	Units	2), 4)
				3-dots	0		
				4-dots	0		
				Density	2	pcs/φ20mm	2), 5)
				Total	7	pcs	2)
			Total	10	pcs		
	2	Line Defect			Serious one is not allowed.	—	—
	3	Uneven Brightness					
	4	Stain Inclusion Line shape W: width (mm) L: length (mm)	W ≤ 0.1	L < 1.0	4	pcs	6)
		L ≥ 1.0		0			
	5	Stain Inclusion Dot shape D: ave. dia. (mm)	D ≤ 0.22		Ignore	pcs	6)
			D ≤ 0.4		5		
			0.4 < D ≤ 0.5		4		
			D > 0.5		0		
	6	Scratch on polarizer Line shape W: width (mm) L: length (mm)	W ≤ 0.02	L: Ignore	Ignore	pcs	7)
W ≤ 0.04			L ≤ 40	10			
			L > 40	0			
W ≤ 0.08			L ≤ 20	10			
			L > 20	0			
W > 0.08			—	0			
7	Scratch on polarizer Dot shape D: ave. dia. (mm)	D ≤ 0.2		Ignore	pcs	7)	
		D ≤ 0.6		10			
		D > 0.6		0			

	No.	Item	Max. acceptable number A-zone	Unit	Note
non- operating inspection	8	Bubbles, peeling in polarizer [D: ave. dia. (mm)]	$D \leq 0.3$	Ignore	pcs 7)
			$D \leq 0.5$	10	
			$D \leq 1.0$	5	
			$D > 1.0$	0	
	9	Wrinkles on polarizer	Serious one is not allowed.	—	—

- Notes 1) Sparkle mode : Brightness of dot is more than 30% at black. (visible to eye)
2) Black mode: Brightness of dot is less than 70% at white. (visible to eye)
3) 1 dot: Defect dot is isolated, not attached to other defect dot.
4) N dots: N defect dots are consecutive. (N means the number of defects dots)
5) Density: Number of defect dots inside 20mm ϕ .
6) Those stains which can be wiped out easily are acceptable.
7) Polarizer area inside of B-zone is not applied.

10. PRECAUTION

Please pay close attention to the following precautions whilst using, handling and mounting the TFT module.

10.1 PRECAUTION FOR HANDLING AND MOUNTING

- (1) Applying excessive force to any part of the module may result in partial deformation of the frame or mould, which could result in permanent damage to the display.
- (2) The module should be held gently and firmly using both hands. In order to avoid internal damage, never hold the module by just one hand. Also never drop or hit the module.
- (3) The module should be installed using the mounting holes of the module. In case of using side mounting hole, chassis thickness should be 1.5mm max.
- (4) Uneven force such as twisted stress should not be applied directly to the module once it is mounted within the cover case. The cover case must have sufficient strength such that any external forces are not transmitted directly to the module.
- (5) It is recommended that you maintain a gap between the display module and the rear chassis so as to avoid any mechanical stress being passed to the module.

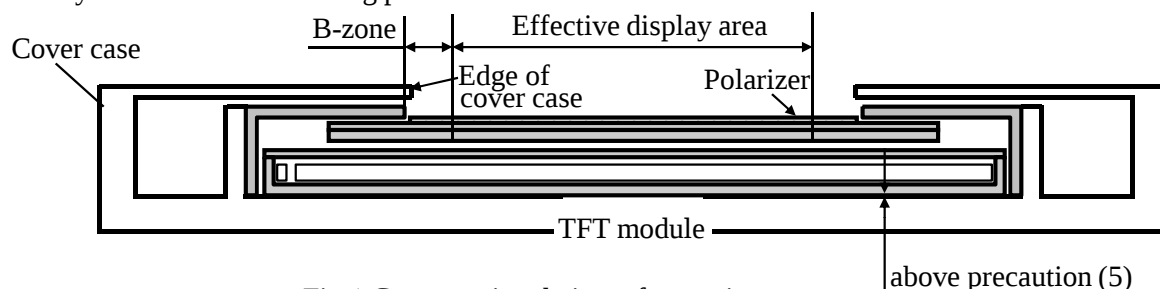


Fig.1 Cross sectional view of a monitor set

- (6) The edge of the cover case should be positioned with more than a 1mm overlap from the edge of the module's upper frame.
- (7) A transparent protective plate should be added to the front of the display in order to protect both the polarizer and TFT cell. The transparent protective plate should have sufficient strength such that the plate can not be deformed, due to external forces, and touch the module.
- (8) Materials containing acetic acid and chlorine should not be used for the cover case nor for other parts which are positioned in close proximity to the module. This is because the Acetic acid will attack the polarizer, whilst the chlorine will attack the electric circuits by way of electro-chemical reaction.
- (9) The front polarizer on the TFT cell should be handled carefully, due to its softness, and must not be touched, pushed or rubbed with glass, tweezers or anything harder than an HB pencil lead.
The surface of the polarizer should not be touched nor rubbed with bare hands, greasy or dusty clothes.
- (10) If the surface of the polarizer becomes dirty it should be gently wiped using an absorbent cotton (Traysee CC clean cloth), chamois or other soft material, slightly dampened with petroleum benzene. IPA (isopropyl alcohol) is recommended to clean away the traces of adhesive which is used to attach the front/rear polarizers to the TFT cell. Other cleaning chemicals such as acetone, toluene and alcohol should not be used to clean adhesives because they cause chemical damage to the polarizer.
- (11) Saliva or water drops should be immediately wiped off. Otherwise, the affected portion of the polarizer may become deformed and its color may fade.
- (12) The module should not be opened or modified, under any circumstances, as this may cause it to malfunction.

- (13) The metallic bezel of the module should not be handled with bare hand or dirty gloves. Otherwise, the color of the metallic frame may become dirty during its storage. It is recommended to use clean soft gloves and clean finger stalls whilst the module is handled during incoming inspection and production assembly processes.
- (14) Please pay attention to the packing and handling not to apply strong Z axis vibration. Because during our vibration test, of course we didn't have any functional failure, but we observed very tiny bright dots (within spec though) at Z axis direction.

10.2 PRECAUTION TO OPERATION

- (1) Spike noise could result in the mis-operation of this module. The level of spike noise should be as follows:
 $-200\text{mV} \leq \text{over- and under- shoot of VDD} \leq +200\text{mV}$
VDD including over- and under- shoot should not exceed the absolute maximum ratings.
- (2) Optical response times, luminance and chromaticity depend on the temperature of the TFT module.
- (3) Sudden temperature changes may cause dew on and/or in the module. Dew can cause damage to the polarizer and/or electrical contacting areas of the module. Dew causes fading of the image quality.
- (4) Using screen saver is recommended that it avoids any potential of sticking image.
- (5) This module has high frequency circuits. Sufficient suppression to electromagnetic interference should be done by the system manufacturers. Grounding and shielding methods may be effective to minimize such interference.
- (6) Noise may be heard when the back-light is operated. If necessary, sufficient suppression should be done by the system manufacturers.
- (7) The module should not be connected or disconnected whilst the main system is operating.
- (8) Connecting or disconnecting the I/F cables, whilst the power and data signals are present, could result in permanent damage to the module. The I/F connectors should only be connected and disconnected after the power supply and data signal have been turned off.
- (9) The ambient temperature near the operated module should be satisfied with the absolute maximum ratings. Unless it meets the specifications, sufficient cooling system should be adopted to system.

10.3 ELECTROSTATIC DISCHARGE CONTROL

- (1) This module consists of a TFT cell and electronic circuits with CMOS-ICs, which are very susceptible to electrostatic discharge. Persons who are handling the module should be grounded through adequate methods such as a wrist band. I/F connector pins should not be touched directly with bare hands.
- (2) The polarizer protective film should be removed slowly so as to avoid an excessive build-up of electrostatic charge.

10.4 PRECAUTION TO STRONG LIGHT EXPOSURE

- (1) The module should not be exposed to strong light. Otherwise, characteristics of the polarizer and color filter, may be degraded.

10.5 PRECAUTION TO STORAGE

When modules are stored, for long period's of time, the following precautions should be taken:

- (1) Modules should be stored in a dark place. It is prohibited to apply direct sunlight or fluorescent light during storage. Modules should be stored between 0 to 35°C at normal humidity (60%RH or less).
- (2) The surface of the polarizer should not come into direct contact with other objects.

It is recommended that modules should be stored in the original Japan Display shipping box.

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10.6 PRECAUTION TO HANDLING PROTECTION FILM

- (1) The protective film for polarizers should be peeled off slowly and carefully by people who are electrically grounded with adequate methods such as wrist bands. Also ionized air should be blown over the module during the peeling process.
Dust on the polarizer should be blown off gently using an ionized nitrogen gun.
- (2) The protective film should be peeled off carefully to avoid it rubbing on the polarizer. If the film rubs together with the polarizer it is possible that a small amount of adhesive may remain on the polarizer.
- (3) The module with protective film should be stored under the conditions explained in 9.5 (1). However, in case's where the storage time is excessive, some adhesive may remain on the polarizer even after the protective film has been removed. In the case where a module is stored at higher temperatures and/or higher humidity, adhesive may remain on the polarizer. Any remaining adhesive may cause non-uniformity of the displayed image.

10.7 SAFETY

- (1) Since the TFT cell is made of glass, handling of any broken module's should be carried out with the utmost care so as to avoid any injury. Hands which have come into direct contact with liquid crystal material should be washed immediately and thoroughly.
- (2) The module should not be taken apart during operation so that back-light drives by high voltage.

10.8 USE RESTRICTIONS AND LIMITATIONS

- (1) In no event shall Japan Display be liable for any incidental, indirect or consequential damages in connection with the installation or use of this product, even if informed of the possibility there of in advance. These limitations apply to all causes action in aggregate, including without limitation breach of contract, breach of warranty, negligence, strict liability, misrepresentation and other torts.
- (2) This product is not authorized for military applications or other applications which pose a significant risk of personal injury.

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